

# Stratospheric Water Inventory, Tomography of Convective Hydration (SWITCH)

Completed Technology Project (2017 - 2020)



## Project Introduction

We propose to develop and test the key transmitter and receiver systems for a spaceborne active microwave occultation sounder system making two-dimensional tomographic atmospheric composition observations with unprecedented spatial resolution (~500m vertical, 10km along track). The measurement approach employs multiple small (e.g., 6U-“CubeSat”-class) transmitters orbiting in the same plane and flight direction as a separate (larger) receiver instrument. The transmitters emit continuous distinct tones, and the receiver observes all transmitters simultaneously and continuously, in an occultation viewing geometry. The vertical resolution of the measurements is set, to first order, by the along-orbit spacing of the transmitters, with the horizontal resolution set by signal to noise and radiative transfer considerations. We will develop the transmitter and receiver elements for such a system operating in the 183-GHz region, incorporating state-of-the-art technologies. The specific science target for this measurement system relates to the impact of small-scale processes (notably overshooting deep convection) on lower stratospheric (~15–20km) water vapor, and hence, given water vapor's role as a greenhouse gas, on climate. Straightforward retuning of the transmitters and receiver (including, potentially, in orbit) enables high resolution measurements of other species, notably ozone, for which other small scale processes (e.g., those driving exchange of air between the stratosphere and troposphere) play important roles in the Earth system. The transmitters will use a CMOS-based ASIC to generate tones in the 10–11GHz range that will then be up-converted to 183–184GHz using a heterodyne mixer driven by a low-power local oscillator ASIC. The receiver will use a MMIC LNA-based front end subsystem developed under the ACT program, in combination with a new FPGA-based digital spectrometer. In addition to being suitable for “stand-alone” flight, the receiver could be incorporated as an additional channel on a future passive microwave limb sounding instrument, such as that being developed to continue and augment the record from the Aura Microwave Limb Sounder. The components used for the transmitters and receiver are currently at TRL-4 or higher. We will design, fabricate and test the transmitter and receiver subsystems and systems, and validate them in laboratory and ground-to-ground configurations. Air-to-air testing will also be performed using a pair of high-altitude balloons, establishing TRL-6 for the measurement approach and its proposed implementation.



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## Organizational Responsibility

### Responsible Mission Directorate:

Science Mission Directorate (SMD)

### Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

### Responsible Program:

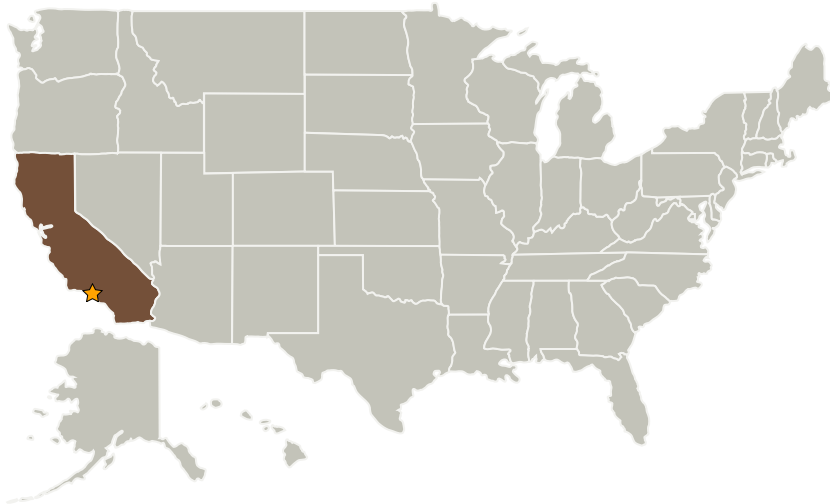
Instrument Incubator

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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Jet Propulsion Laboratory (JPL)	Lead Organization	NASA Center	Pasadena, California

## Primary U.S. Work Locations

California

## Project Management

### Program Director:

Pamela S Millar

### Program Manager:

Parminder S Ghuman

### Principal Investigator:

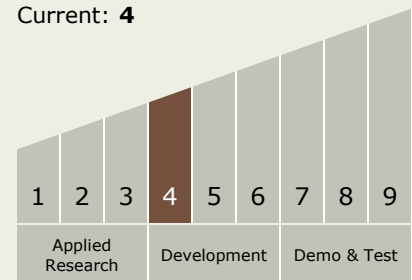
Nathaniel J Livesey

### Co-Investigators:

Robert F Jarnot  
Theodore J Reck  
Karen R Piggee  
William G Read  
Mau-chung Frank Chang  
Goutam Chattopadhyay  
Adrian J Tang  
Jonathon Kocz  
Robert A Stachnik  
Jacob W Kooi  
Sharmila Padmanabhan

## Technology Maturity (TRL)

Start: 4  
Current: 4



## Technology Areas

### Primary:

*Continued on following page.*

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## Technology Areas (cont.)

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
    - └ TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

## Target Destination

Earth